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# FIG. 1
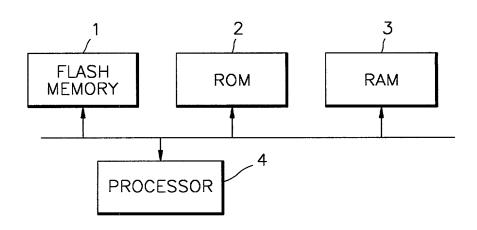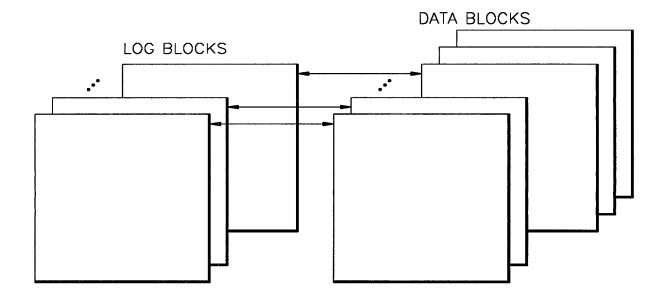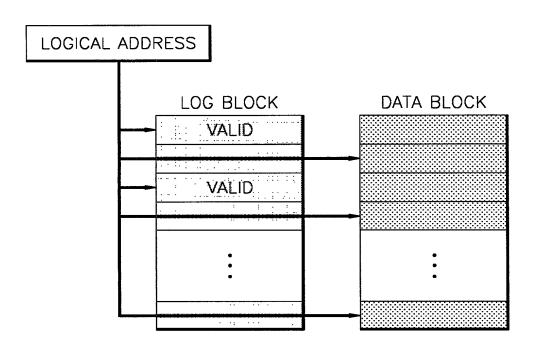


# FIG. 2

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# FIG. 3

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# FIG. 4

FLASH MEMORY

| MAP |
|-----|
| LOG BLOCKS |
| DATA BLOCKS |
| FREE BLOCKS |

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# FIG. 5

FLASH MEMORY

| MAP |
| :---: |
| CHECK POINT |
| LOG BLOCKS |
| DATA BLOCKS |
| FREE BLOCKS |

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# FIG. 6

LOG POINTER TABLE

| ENTRY |
|-------|
| ENTRY |
| ENTRY |
| ⋮ |
| ENTRY |

LOGICAL ADDRESS

FLASH MEMORY

# FIG. 7

| ← BLOCK ADDRESSING → | | PAGE ADDRESSING → |
|---|---|---|
| log_blk | phy_blk | page #0 |
| | | page #1 |
| | | page #2 |
| | | ⋮ |
| | | page #N |

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# FIG.  8

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# FIG. 9

FLASH MEMORY

## LOG POINTER TABLE ENTRY

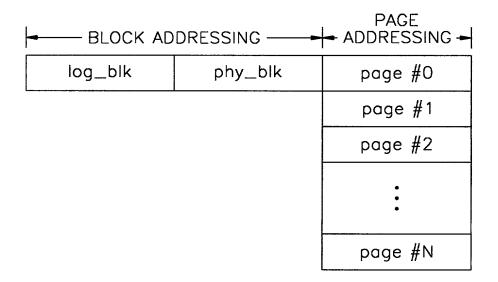| log_blk | phy_blk | page #0 |
|---------|---------|---------|
|         |         | page #1 |
|         |         | page #2 |
|         |         | ⋮ |
|         |         | page #15 |

LOG BLOCK

DATA BLOCK

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# FIG. 10

| DATA BLOCK | FREE BLOCK | LOG BLOCK |
|:---:|:---:|:---:|
| INVAILD | FREE | VAILD |
| INVAILD | FREE | INVAILD |
| INVAILD | FREE | VAILD |
| VAILD | FREE | VAILD |
| ⋮ | ⋮ | ⋮ |
| VAILD | FREE | FREE |

# FIG. 11

| DATA BLOCK | LOG BLOCK |
|:---:|:---:|
| INVAILD | VAILD |
| INVAILD | VAILD |
| VAILD | FREE |
| VAILD | FREE |
| ⋮ | ⋮ |
| VAILD | FREE |

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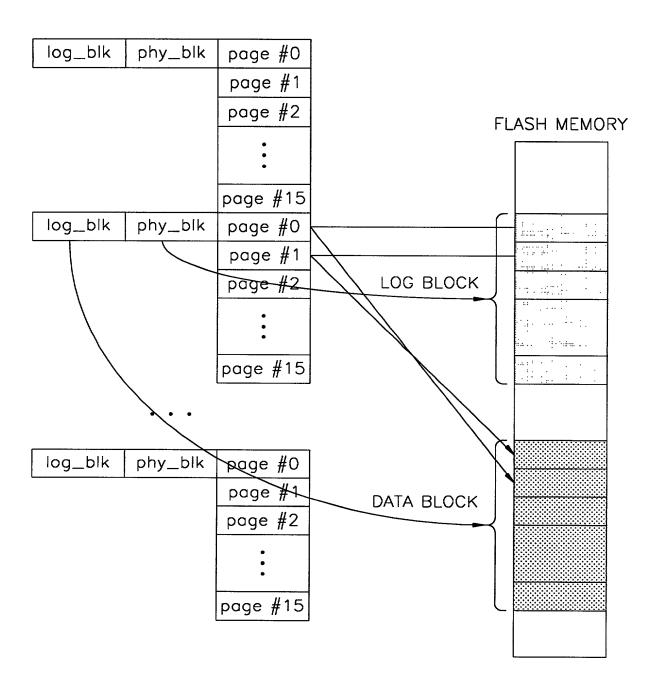Filed: December 31, 2001
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# FIG. 12

FREE
BLOCK

WRITE

ERASE

WRITE

LOG
BLOCK

SIMPLE MERGE

ERASABLE
BLOCK

SWITCH MERGE
COPY MERGE

DATA
BLOCK

SIMPLE MERGE
SWITCH MERGE
COPY MERGE

FREE PAGE

VALID PAGE

INVAILD PAGE
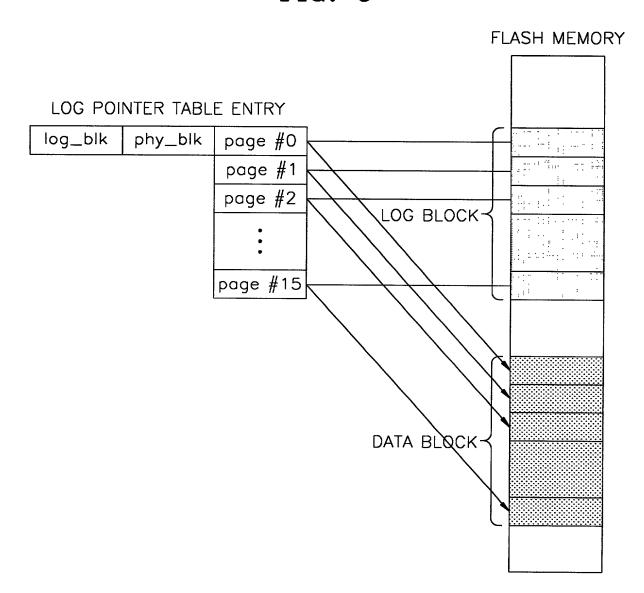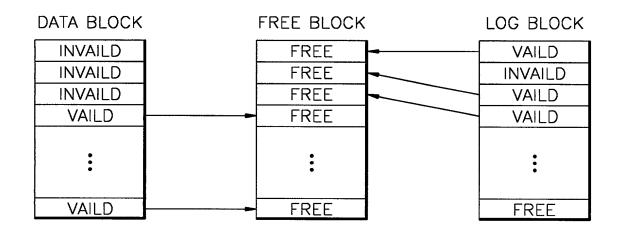
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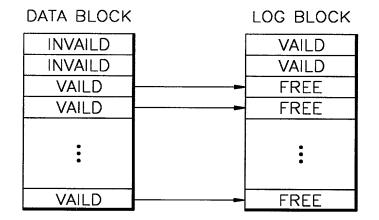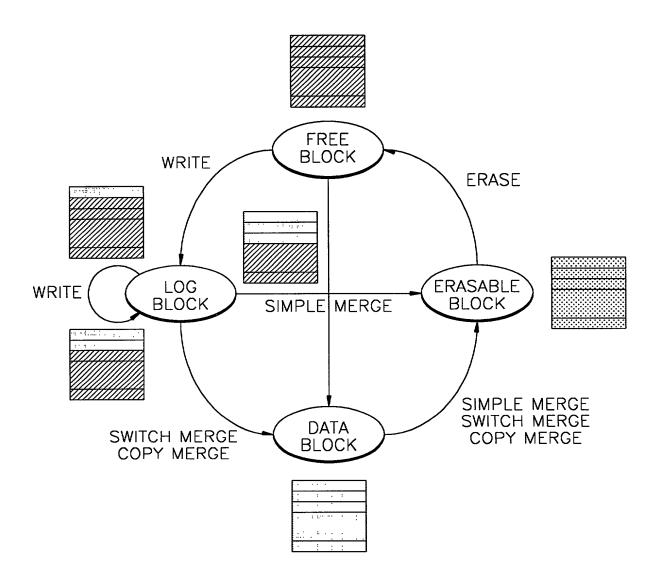# FIG. 13

```
                    ┌──────────┐
                    │   READ   │
                    └────┬─────┘
                         │
          ┌──────────────────────────────┐
          │ SEARCH LOG POINTER TABLE      │——— 1301
          │   WITH LOGICAL ADDRESS        │
          └──────────────┬───────────────┘
                         │            1302
                    ◇─────────────◇              NO
                   ╱  IS ENTRY FOUND? ╲───────────────────┐
                    ◇─────────────◇                       │
                         │ YES                            │
          ┌──────────────────────────────┐               │
          │      SEARCH FOR ENTRY         │——— 1303       │
          └──────────────┬───────────────┘               │
                         │        1304                    │
                    ◇─────────────◇              NO       │
                   ╱   IS REQUESTED  ╲──────────────────┐ │
                    ╲  PAGE FOUND?   ╱                  │ │
                    ◇─────────────◇                     │ │
                     │ YES   1305                 1306  │ │
          ┌────────────────────┐       ┌────────────────────┐
          │   READ PAGE        │       │    READ PAGE       │
          │   IN LOG BLOCK     │       │   IN DATA BLOCK    │
          └─────────┬──────────┘       └─────────┬──────────┘
                    │                            │
                    │◄───────────────────────────┘
              ┌──────────┐
              │   END    │
              └──────────┘
```

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# FIG. 14



WRITE

↓

SEARCH LOG POINTER TABLE
WITH LOGICAL ADDRESS — 1401

↓

IS ENTRY FOUND? — 1402

NO → ...

YES ↓

IS PAGE
AT SAME POSITION
USABLE? — 1403

NO → ...

YES ↓

WRITE TO
CORRESPONDING
PAGE IN LOG
BLOCK — 1404

1406
CAN
FREE PAGE BE
ALLOCATED IN LOG
BLOCK?

YES ↓

WRITE TO
ALLOCATED PAGE — 1407

1408
CAN
NEW LOG BLOCK
BE ALLOCATED?

YES → ...

NO ↓

ALLOCATE LOG BLOCK
AFTER BLOCK MERGE — 1409

↓

WRITE TO PAGE
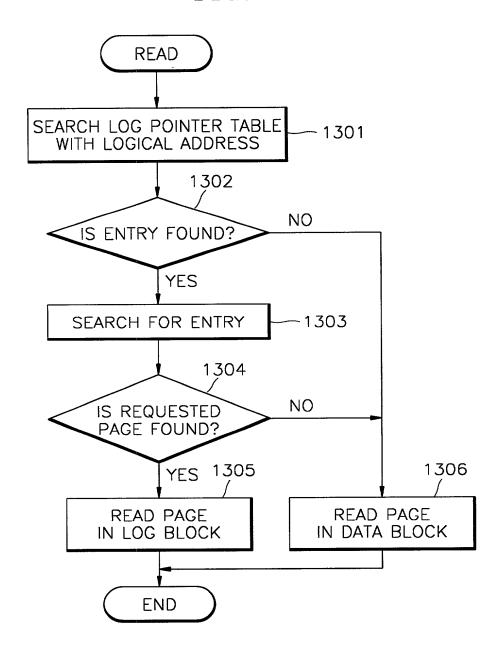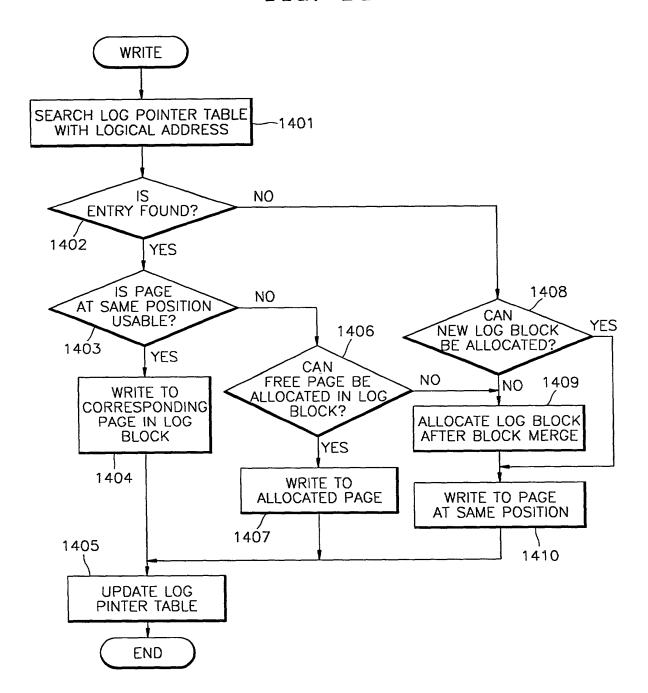AT SAME POSITION — 1410

1405
UPDATE LOG
PINTER TABLE

↓

END

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# FIG. 15



BLOCK MERGE

1501 — ARE ALL PAGES IN LOG BLOCK LOCATED AT SAME POSITIONS?

NO → SIMPLE MERGE

1506 — WRITE RECOVERY INFORMATION

1507 — ALLOCATE FREE BLOCKS TO COPY VALID PAGES OF LOG BLOCK

1508 — COPY REMAINING UNCOPIED PAGES FROM DATA BLOCK

1509 — UPDATE ADDRESS CONVERSION INFORMATON SO THAT FREE BLOCK IS NEW DATA BLOCK

1510 — ERASE LOG BLOCK AND DATA BLOCK AND UPDATE FREE BLOCK LIST

YES

1502 — ARE ALL PAGES IN LOG BLOCK VALID?

NO →

1511 — WRITE RECOVERY INFORMATION

1512 — READ VALID PAGES OF DATA BLOCK AND COPY THEM TO LOG BLOCK

YES → SWITCH MERGE

1503 — WRITE RECOVERY INFORMATION

1504 — UPDATE ADDRESS CONVERSION INFORMATON SO THAT LOG BLOCK IS NEW DATA BLOCK

1505 — ERASE LOG BLOCK TO UPDATE FREE BLOCK LIST

END